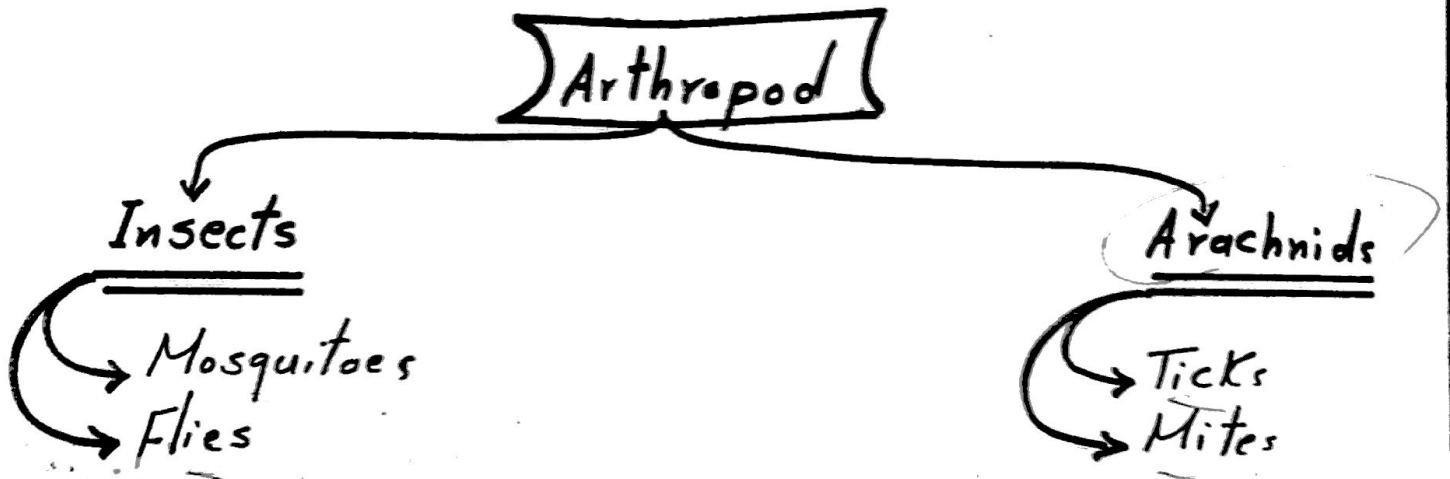


Entomology

- Arthropod → Invertebrate animal with hard chitinated exoskeleton & jointed appendages



- Body of arthropod may consists of :-

- ① 3 segments → Insects.
- ② 2 ~ → scorpion & spider.
- ③ 1 segment → Tick & mite.

General morphology of arthropod

① Exoskeleton

- consists of chitin → For hardness & protection.

- It divides the body into 3 segments →

Each segment consists of :-

① Tergum → Dorsal region.

② sternum → ventral region.

③ pleurons → 2 Lateral regions.

→ Head
→ Thorax
→ Body Abdomen

①

② Integument

- For production of hairs, scales & spines

③ Digestive system.

- consists of:-

① Fore gut → begin with proboscis (mouth part) →
Buccal cavity [contain salivary glands] →
pharynx → esophagus → proventriculus

② Mid gut → stores Food & produce enzymes
for digestion.

③ Hind gut → consists of ilium & rectum

④ Salivary glands →

- 2 pairs opening into buccal cavity
- Labial salivary glands → open into Labium.
- Hepatic ceca → 6-8 blind tubes opening at
Junction of gizzard & true stomach &
secrete digestive enzymes

④ Coelom (Body cavity)

- called Haemocoel & contain blood and Lymph
(Haemolymph)

⑤ Excretory system

- consists of Malpighian tubules which open into
the alimentary canal. ②

⑥ Circulatory system

- Has primitive tubular heart which has opening called ostia through which the haemolymph enters the heart.

⑦ Respiratory system

③ Tracheal system

- The most common type of respiration
- The air enters trachea through paired Lateral openings in the pleurons called (stigma or spiracles) → then → enter branching system of trachea & tracheoles
- occur in
 - Adult Flying arthropods
 - Mosquitoes Larvae

- ⑥ Tracheal gills → It is closed tracheal system
 - occur in aquatic arthropods

- ③ Lung books → In spiders

- ④ Direct cuticular respiration → In mites

⑧ Nervous system

- consists of nerve cord which is connected to supraesophageal ganglion in the brain.

③

Sensory organs

② Eyes

- May be
 - Reduced → in tick & Lice
 - well-developed → blood sucking flies
- Female eyes → Dichoptic → separated eyes.
- Male eyes → Holoptic → very close together
- ocelli → are simple eyes present on the top of Head.
 - Differentiate Light From dark

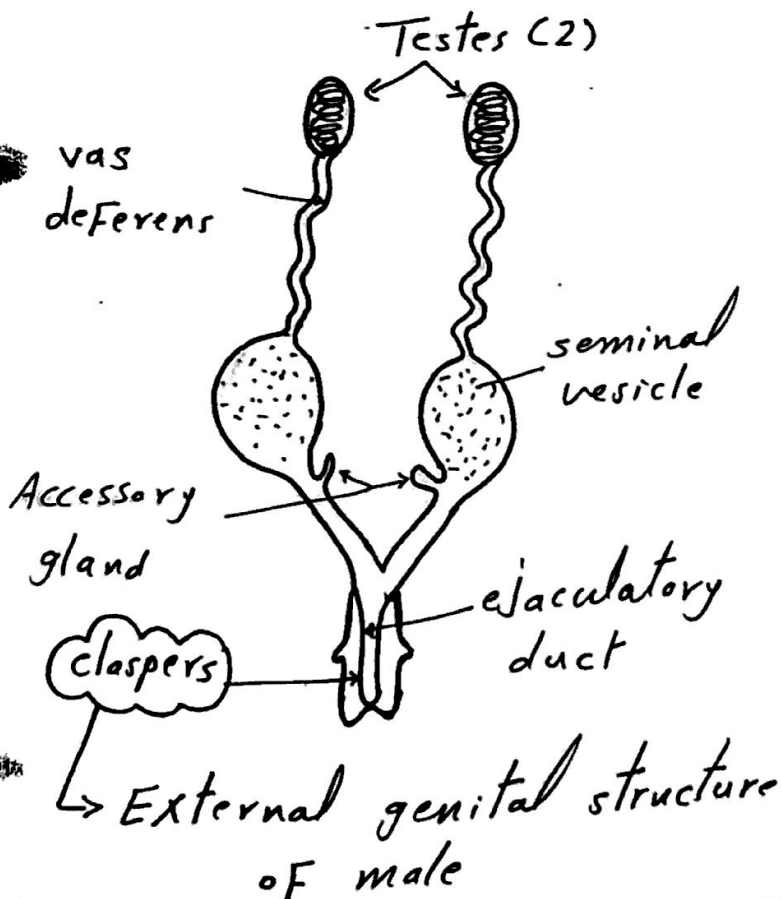
⑥ Antennae

⑦ Palps

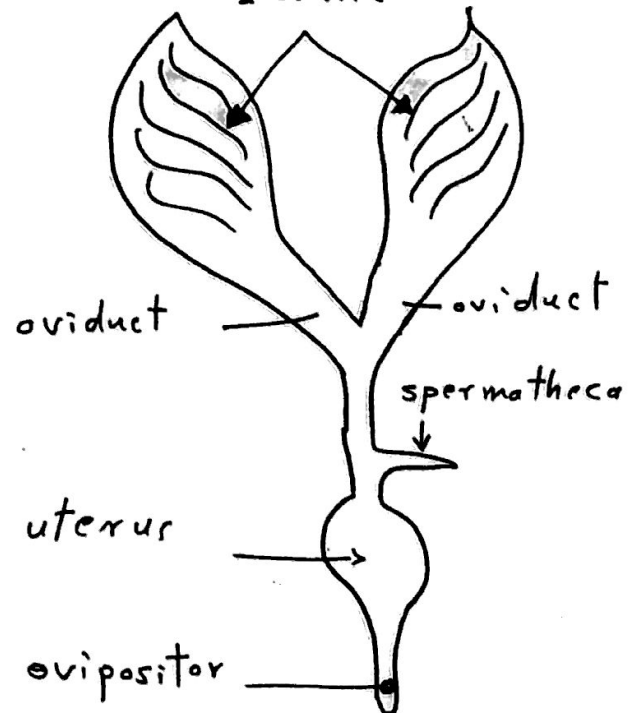
⑧ Hairs

⑨ Genital system

- Male genital system



Female genital system 2 ovaries



Development of arthropods

- Female may be

- oviparous → Lay egg ex → *Musca domestica*
- viviparous → Lay Larva ex → *Sarcophaga*
- pupiparous → Lay Larva ready to pupate at once ex → *Glossina*

- After mating → oviposition occur in suitable breeding site from humidity & temperature.

- Young insect when hatch from egg may be :

② Ametabolic insect → Resemble their adults

① Metabolic insect → Differs from their adults & require to undergo Metamorphosis

- Metamorphosis → Morphological & developmental changes which occur to the hatched insect (metabolic) to resemble their adults

① Holometabola (Complete Metamorphosis)	② Hemimetabola (Incomplete Metamorphosis)
<p>There is complete change in morphology & feed habits of Larva from adult</p> <p style="text-align: right;">→ enclosed → Non-Feeding</p> <p>Egg $\xrightarrow{\text{hatch}}$ Larva $\xrightarrow{\text{moult}}$ pupa</p> <p style="text-align: center;">Adult $\xleftarrow{\text{shed skin}}$</p> <p>Ex → Flies, Mosquitoes & Fleas</p>	<p>The hatched Larva resemble their adults except in :-</p> <ul style="list-style-type: none"> ② size ③ absence of reproductive organs <p>Egg → Larva → Nymph → Adult.</p> <p>Ex → tick, mite, lice & cockroaches</p>

④

⑤

veterinary Medical importance of arthropods

① Arthropod as direct agent of disease or discomfort

- ① **Entomophobia** → Fear From insect
- Animal is excited when hear sound of insect (Mosquitoes, oestrus ovir) & doesn't Feed.
- ② **Accidental injury** to sense organs → when insects enter eyes or ears
- ③ **Envenomization** → some arthropods secrete poisons from poisonous glands.
- ④ **Dermatosis** or skin irritation due to mechanical bite of mosquitoes & Flies.
- ⑤ **Allergy & sensitivity** to insect secretions → saliva of arthropods has irritant substances.

① **Myiasis**

② Transmission of disease agents

① Mechanical Transmission

- May be

① Internally → Arthropod swallow the pathogen which pass through the alimentary canal in feces

- Ent. Histolytica → By Musca domestica without change.
- Tryp. evansi → ~ tabanus & stomoxys
- Tryp. equinum → ~ ~ ~

⑥

① Externally

- Through contamination of external body surface of arthropod (Legs, wings, proboscis) by pathogen.
- Neither multiplication nor development occur.

② Biological Transmission

- The pathogen multiply and / or change (develop) to another form.

① propagative transmission → The pathogen ↑ only in number without development inside the arthropod vector.

- Endemic typhus → Lice
- plague → Fleas

② cyclodevelopmental → The pathogen inside vector undergo cyclic development without ↑ in number.

- Filarial worms in mosquitoes.

③ cyclopropagative → The pathogen inside the vector undergo cyclic development & ↑ in number

- plasmodium species → in mosquitoes.
- Leishmania ~ → ~ sand Fly.
- Trypanosoma ~ → ~ Glossina.

④ Transovarian → As cyclopropagative but → The pathogen transmitted through ovaries of adult ♀ vector to its offsprings.

- Babesia Bigemina → By hard tick.

(Arthropoda)

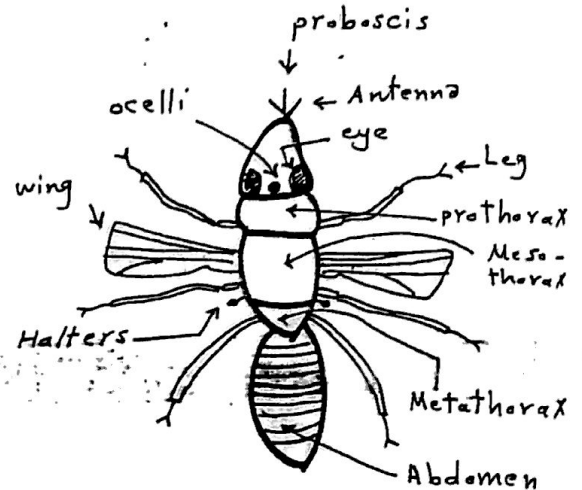
- ① Insecta ② Arachnida ③ Crustacea ④ Myriapoda ⑤ Pentastomida

① Insecta = Hexapoda = Antennata

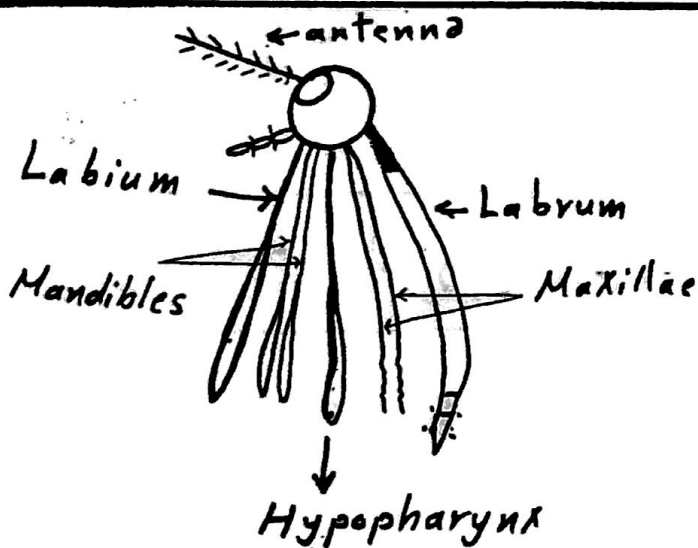
General characters

① Head

- consist of 6 fused segments
- Head carries
 - pair of eyes
 - pair of antennae
 - proboscis (Mouth part)



Basic structure of proboscis



- ① Labrum (Upper Lip)
- ② Jaws
 - paired maxillae
 - ~ Mandibles
- Maxillae may carry maxillary palps which are sensory for food.
- ③ Hypopharynx → similar to tongue.
- ④ Labium (Lower Lip) → May carry sensory labial palp

- Food channel → Formed by Hypopharynx & Labrum

- proboscis may be adapted for

- Biting & chewing
- piercing & sucking
- sucking only

② Thorax

- consists of 3 segments

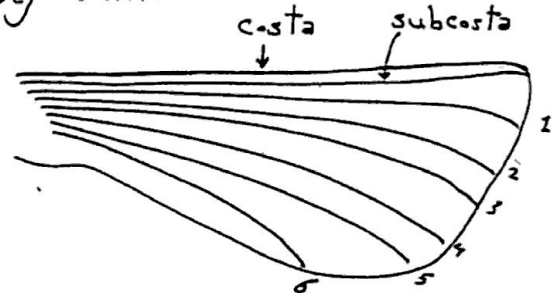
- prothorax
- Meso-thorax
- Meta-thorax

Each segment has pair of jointed Legs ③

- Thorax → In some insects → Has 2 pairs of wings
- In Diptera → Has → pair of Functional wings
- pair of reduced wings (Halters)
- In Fleas, Lice & bugs → wing-Less

- Functional wings → Arise From mesothorax & supported by 6 hollow tubes called wing veins

- Halters → small knob-like sensory structure
- Has balancing Function



③ Abdomen

- consists of up to 11 segments

- The Last (terminal) segment is modified to form the external genitalia


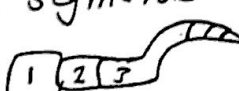



- In ♀ → ovipositor.
- In ♂ → claspers.

Classification of Insecta

- ① Diptera → Mosquitoes & Flies
- ② Siphonaptera → Fleas
- ③ Phthiraptera → Lice
- ④ Hemiptera → Bugs
- ⑤ Orthoptera → Cockroaches & Grasshopper
- ⑥ Coleoptera → Beetles & weevils
- ⑦ Hymenoptera → Ants, Bees, & wasps.

Diptera

classified into

	Nematocera	Brachycera	Cyclorrhapha
size	small (only 7 parasitic)	Large (7 parasitic)	medium (1-7 parasitic)
Antenna	Long, hairy & 15 segments 	3 segments 	3 segments & arista 
maxillary palp	4-5 segments	2-3 segments	1 segment
Wing	No cross veins	cross veins	Limited cross veins
emergence From pupa	From T-shaped opening (Orthorrhapha) 	The same	From circular opening at anterior end through ptilinal sac [Cyclorrhapha] 
Egg	Laid in water	on shallow water	Laid on ground
Larva ↳ Head	well-developed - Aquatic	ill-developed Aquatic	poorly-developed. - Terrestrial - Maggot-like
pupa	obtectate → Free ↳ mobile - Aquatic	- obtectate - Aquatic	- coarctate → Not Free ↳ Non-mobile - Terrestrial

① Nematocera

- ① culicidae
- ② psychodidae
- ③ ceratopogonidae
- ④ simuliidae

⑤

① Suborder: Nematocera

① Mosquitoes (Culicidae)

Antenna → 15 segment  → pilose → Fine, short hairs
→ pubescent → dense, Long

Abdomen → 10 segments

proboscis → ♀ Adapted For piercing & sucking.

♂ → Non-parasitic & Adapted For chewing
→ Mandibles & Maxillae → Reduced

(5...)(5...7)

Med. Imp. of Mosquitoes

1- Nocturnal Feeding & painful

2- Act as vectors For

④ Anopheles

1- Malaria of Man.

2- Filariasis of dog

3- Fowl spirochaeta

4- Equine Encephalomyelitis.

⑧ Culex & Aedes

1- Malaria of Birds

2- Filariasis of Dog

3- ~ ~ Man

Culex

→ Fowl spirochaeta

→ African horse sickness

Aedes → Yellow Fever

→ Equine Encephalomyelitis

→ Rift valley Fever

Larva of Mosquitoes

Worm-like

- wing-less

- No Legs

Head → 2 Antennae
→ 2 Mouth brushes

Thorax → 3 Fused segments

Each segment → has

Lateral tuft of hairs

Abdomen

- 10 segments

- 1st 7 segments → similar

8th segment

↳ has → siphon tube

↳ comb

9th segment → Reduced

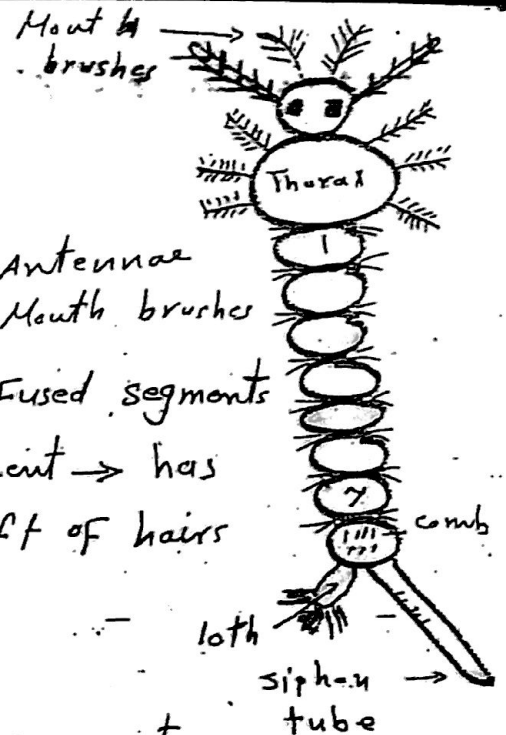
10th segment (Anal segment) →



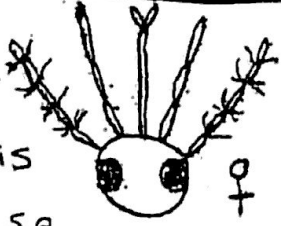
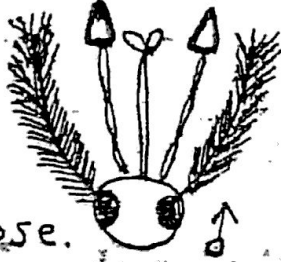
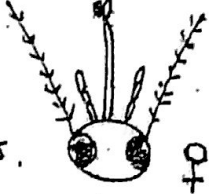




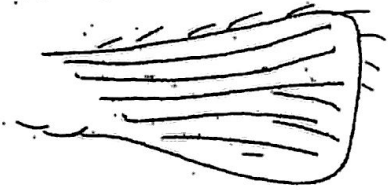


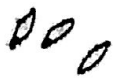
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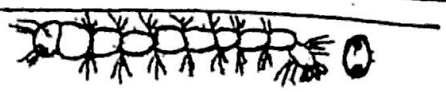
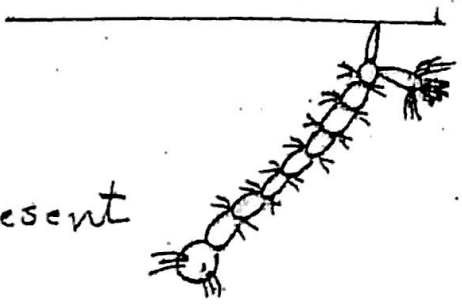


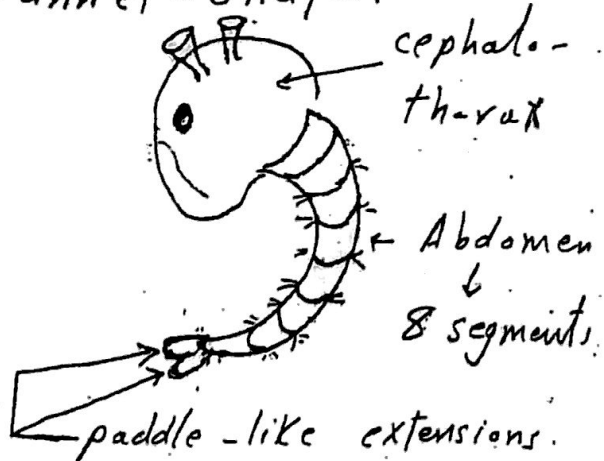
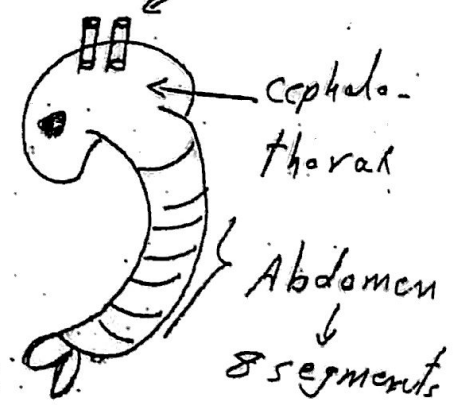
By → 4 papillae

→ Anal gills

- 10-



Item	Anophilini (Anopheles).	Culicini $\begin{cases} \rightarrow \text{Culex.} \\ \rightarrow \text{Aedes.} \end{cases}$
Adult position	 Rest with angle to surface	 Rest parallel to the surface
Maxillary palp	<p>→ ♀ Long as proboscis Antenna → pilose</p> <p>→ ♂ Long as proboscis Bulbed. Antenna → plumose.</p>  	<p>short than proboscis. Antenna → pilose.</p> <p>Long as proboscis not-bulbed. Antenna → plumose.</p>  
Scutellum	Curved (monolobed) Hair 	TriLobed 
Wing	Brown spots on costal margin 	Non-spotted 
Egg	Laid singly & Boat-shape Has paired Lateral floats 	<p><u>Culex</u> - Laid in rafts (50-200) </p> <p>- Has floating apparatus (micropyl) at one pole.</p> <p><u>Aedes</u> - Laid singly  - No float.</p>

Item	Anopheles	Culex & Aedes
<u>Larva</u>		
Resting position	Rest parallel to water surface Feed on materials present on water surface	Hangs head down from water surface & feed below water surface.
Siphon tube	 <p>Absent but has respiratory spiracles on 8th abdominal segment.</p>	 <p>present → Culex → Tubular → Aedes → Barrel-shape.</p>
Comb	Absent	  <p>present → Culex → several rows. → Aedes → single row.</p>
palmate hair	on dorsal surface of abdomen.	Absent
<u>Pupa</u>		
Respiratory trumpets	<p>short, broad & funnel-shape.</p>  <p>cephalo-thorax Abdomen ↓ 8 segments paddle-like extensions.</p>	<p>Long & narrow ← Respiratory trumpets</p>  <p>cephalo-thorax Abdomen ↓ 8 segments</p>

5.7C Life cycle of Mosquitoes

→ Anopheles.
→ Culex.
→ Aedes.

Although mating occur in the air → The other developmental stages are aquatic.

Adult ♀ (oviparous) ←

(After mating & Blood meal)

نكاح أمها في الماء الجيد

Lay eggs
on water surface

من الجيد

up to 300 Egg

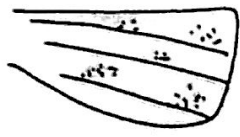

- Single → Anopheles.

→ Aedes.

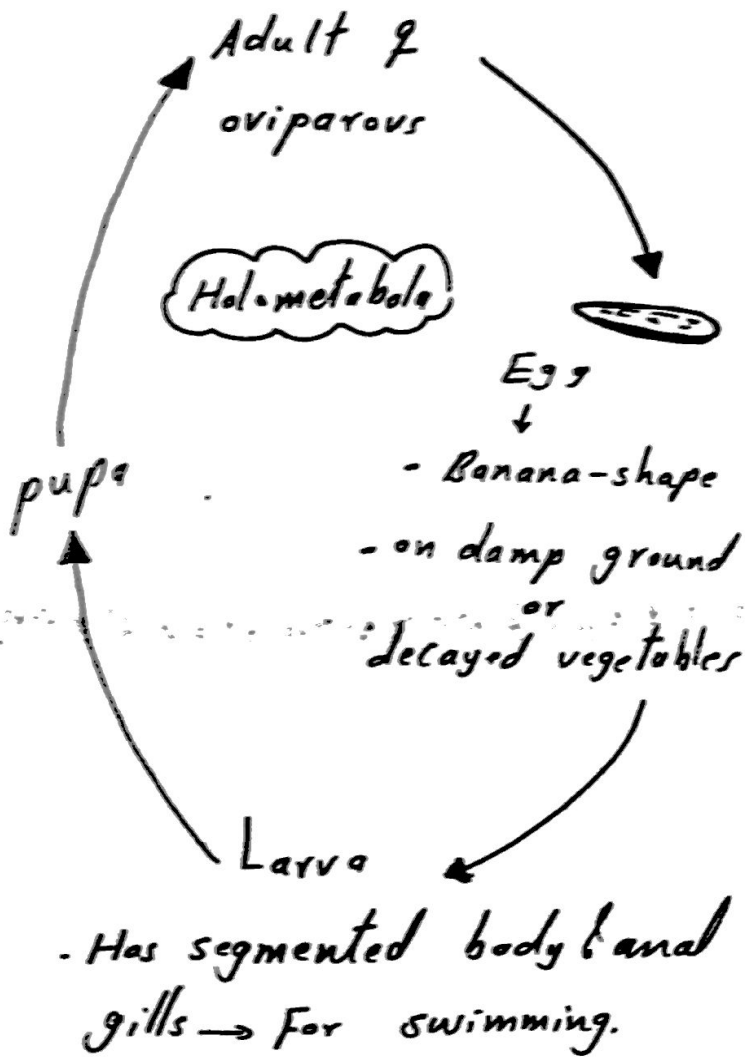
- Egg raft → Culex

Adult emerge from T-shape opening (orthorrhapha)

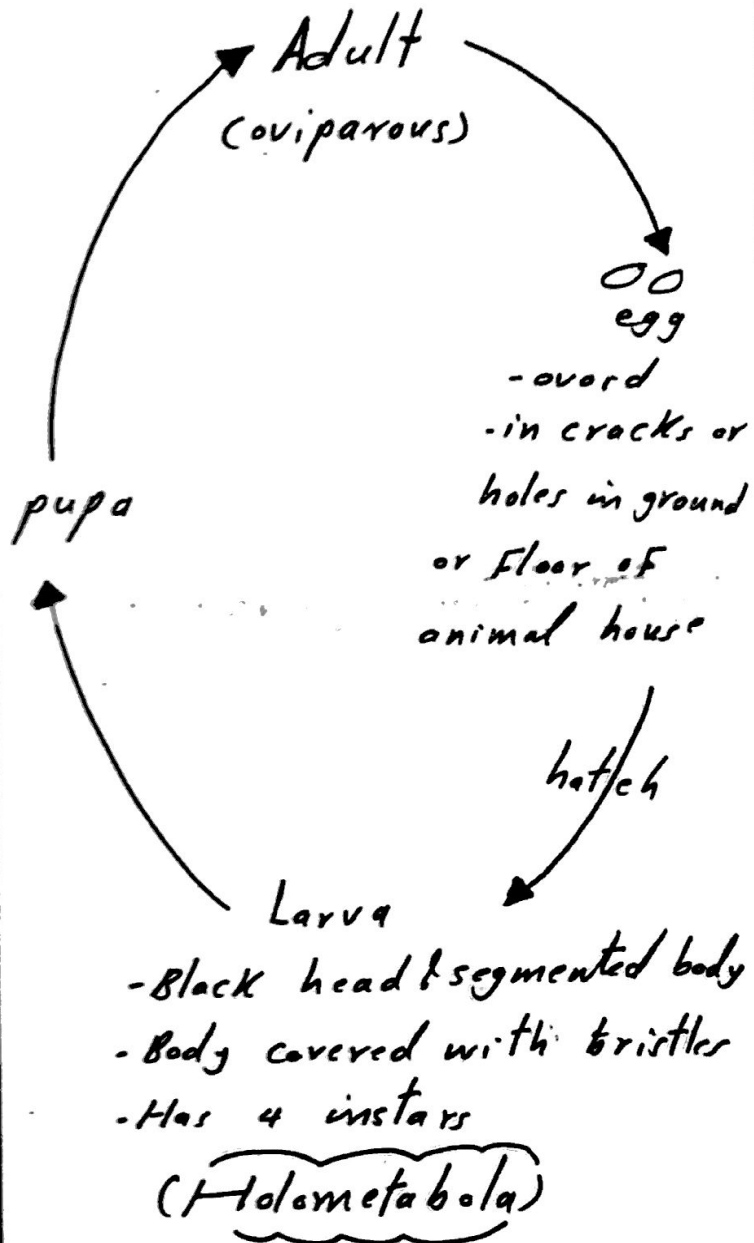
(2-3-5-7-9-11-13-15-17-19-21-23-25-27-29-31-33-35-37-39-41-43-45-47-49-51-53-55-57-59-61-63-65-67-69-71-73-75-77-79-81-83-85-87-89-91-93-95-97-99-101-103-105-107-109-111-113-115-117-119-121-123-125-127-129-131-133-135-137-139-141-143-145-147-149-151-153-155-157-159-161-163-165-167-169-171-173-175-177-179-181-183-185-187-189-191-193-195-197-199-201-203-205-207-209-211-213-215-217-219-221-223-225-227-229-231-233-235-237-239-241-243-245-247-249-251-253-255-257-259-261-263-265-267-269-271-273-275-277-279-281-283-285-287-289-291-293-295-297-299-301-303-305-307-309-311-313-315-317-319-321-323-325-327-329-331-333-335-337-339-341-343-345-347-349-351-353-355-357-359-361-363-365-367-369-371-373-375-377-379-381-383-385-387-389-391-393-395-397-399-401-403-405-407-409-411-413-415-417-419-421-423-425-427-429-431-433-435-437-439-441-443-445-447-449-451-453-455-457-459-461-463-465-467-469-471-473-475-477-479-481-483-485-487-489-491-493-495-497-499-501-503-505-507-509-511-513-515-517-519-521-523-525-527-529-531-533-535-537-539-541-543-545-547-549-551-553-555-557-559-561-563-565-567-569-571-573-575-577-579-581-583-585-587-589-591-593-595-597-599-601-603-605-607-609-611-613-615-617-619-621-623-625-627-629-631-633-635-637-639-641-643-645-647-649-651-653-655-657-659-661-663-665-667-669-671-673-675-677-679-681-683-685-687-689-691-693-695-697-699-701-703-705-707-709-711-713-715-717-719-721-723-725-727-729-731-733-735-737-739-741-743-745-747-749-751-753-755-757-759-761-763-765-767-769-771-773-775-777-779-781-783-785-787-789-791-793-795-797-799-801-803-805-807-809-811-813-815-817-819-821-823-825-827-829-831-833-835-837-839-841-843-845-847-849-851-853-855-857-859-861-863-865-867-869-871-873-875-877-879-881-883-885-887-889-891-893-895-897-899-901-903-905-907-909-911-913-915-917-919-921-923-925-927-929-931-933-935-937-939-941-943-945-947-949-951-953-955-957-959-961-963-965-967-969-971-973-975-977-979-981-983-985-987-989-991-993-995-997-999-1001-1003-1005-1007-1009-1011-1013-1015-1017-1019-1021-1023-1025-1027-1029-1031-1033-1035-1037-1039-1041-1043-1045-1047-1049-1051-1053-1055-1057-1059-1061-1063-1065-1067-1069-1071-1073-1075-1077-1079-1081-1083-1085-1087-1089-1091-1093-1095-1097-1099-1101-1103-1105-1107-1109-1111-1113-1115-1117-1119-1121-1123-1125-1127-1129-1131-1133-1135-1137-1139-1141-1143-1145-1147-1149-1151-1153-1155-1157-1159-1161-1163-1165-1167-1169-1171-1173-1175-1177-1179-1181-1183-1185-1187-1189-1191-1193-1195-1197-1199-1201-1203-1205-1207-1209-1211-1213-1215-1217-1219-1221-1223-1225-1227-1229-1231-1233-1235-1237-1239-1241-1243-1245-1247-1249-1251-1253-1255-1257-1259-1261-1263-1265-1267-1269-1271-1273-1275-1277-1279-1281-1283-1285-1287-1289-1291-1293-1295-1297-1299-1301-1303-1305-1307-1309-1311-1313-1315-1317-1319-1321-1323-1325-1327-1329-1331-1333-1335-1337-1339-1341-1343-1345-1347-1349-1351-1353-1355-1357-1359-1361-1363-1365-1367-1369-1371-1373-1375-1377-1379-1381-1383-1385-1387-1389-1391-1393-1395-1397-1399-1401-1403-1405-1407-1409-1411-1413-1415-1417-1419-1421-1423-1425-1427-1429-1431-1433-1435-1437-1439-1441-1443-1445-1447-1449-1451-1453-1455-1457-1459-1461-1463-1465-1467-1469-1471-1473-1475-1477-1479-1481-1483-1485-1487-1489-1491-1493-1495-1497-1499-1501-1503-1505-1507-1509-1511-1513-1515-1517-1519-1521-1523-1525-1527-1529-1531-1533-1535-1537-1539-1541-1543-1545-1547-1549-1551-1553-1555-1557-1559-1561-1563-1565-1567-1569-1571-1573-1575-1577-1579-1581-1583-1585-1587-1589-1591-1593-1595-1597-1599-1601-1603-1605-1607-1609-1611-1613-1615-1617-1619-1621-1623-1625-1627-1629-1631-1633-1635-1637-1639-1641-1643-1645-1647-1649-1651-1653-1655-1657-1659-1661-1663-1665-1667-1669-1671-1673-1675-1677-1679-1681-1683-1685-1687-1689-1691-1693-1695-1697-1699-1701-1703-1705-1707-1709-1711-1713-1715-1717-1719-1721-1723-1725-1727-1729-1731-1733-1735-1737-1739-1741-1743-1745-1747-1749-1751-1753-1755-1757-1759-1761-1763-1765-1767-1769-1771-1773-1775-1777-1779-1781-1783-1785-1787-1789-1791-1793-1795-1797-1799-1801-1803-1805-1807-1809-1811-1813-1815-1817-1819-1821-1823-1825-1827-1829-1831-1833-1835-1837-1839-1841-1843-1845-1847-1849-1851-1853-1855-1857-1859-1861-1863-1865-1867-1869-1871-1873-1875-1877-1879-1881-1883-1885-1887-1889-1891-1893-1895-1897-1899-1901-1903-1905-1907-1909-1911-1913-1915-1917-1919-1921-1923-1925-1927-1929-1931-1933-1935-1937-1939-1941-1943-1945-1947-1949-1951-1953-1955-1957-1959-1961-1963-1965-1967-1969-1971-1973-1975-1977-1979-1981-1983-1985-1987-1989-1991-1993-1995-1997-1999-2001-2003-2005-2007-2009-2011-2013-2015-2017-2019-2021-2023-2025-2027-2029-2031-2033-2035-2037-2039-2041-2043-2045-2047-2049-2051-2053-2055-2057-2059-2061-2063-2065-2067-2069-2071-2073-2075-2077-2079-2081-2083-2085-2087-2089-2091-2093-2095-2097-2099-2101-2103-2105-2107-2109-2111-2113-2115-2117-2119-2121-2123-2125-2127-2129-2131-2133-2135-2137-2139-2141-2143-2145-2147-2149-2151-2153-2155-2157-2159-2161-2163-2165-2167-2169-2171-2173-2175-2177-2179-2181-2183-2185-2187-2189-2191-2193-2195-2197-2199-2201-2203-2205-2207-2209-2211-2213-2215-2217-2219-2221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	Family: ceratopogonida ② (biting midges) (culicoides)	Family: psychodidae ③ [sand fly = hairy fly = phlebotomus]
Morph.	small 2 mm short legs Has humped thorax	small 5 mm Long legs Has humped thorax & hairy appearance. Has Large black eyes
Antenna	Long 15 segments ♂ → pulvose ♀ → pilose	Long 16 segments & beaded.
wings	Mottled & held at rest in form of closed pair of scissors 	Lanceolated & covered by hairs at rest → erected over the body 
proboscis	For piercing & sucking only ♀ blood sucker - Hanged vertically	→ same → same - Recovered on both sides
Med. imp.		

Life cycle of culicoides



Life cycle of sand fly



Med. imp

- ① Fly in groups → Annoyance to animals & Man.
- ② Sweeting itch on withers of Horse.
- ③ Transmission of :-
 - ① Blue tongue
 - ② African Horse sickness
 - ③ Filaroid nematode [*Onchocerca*]

Med. imp.

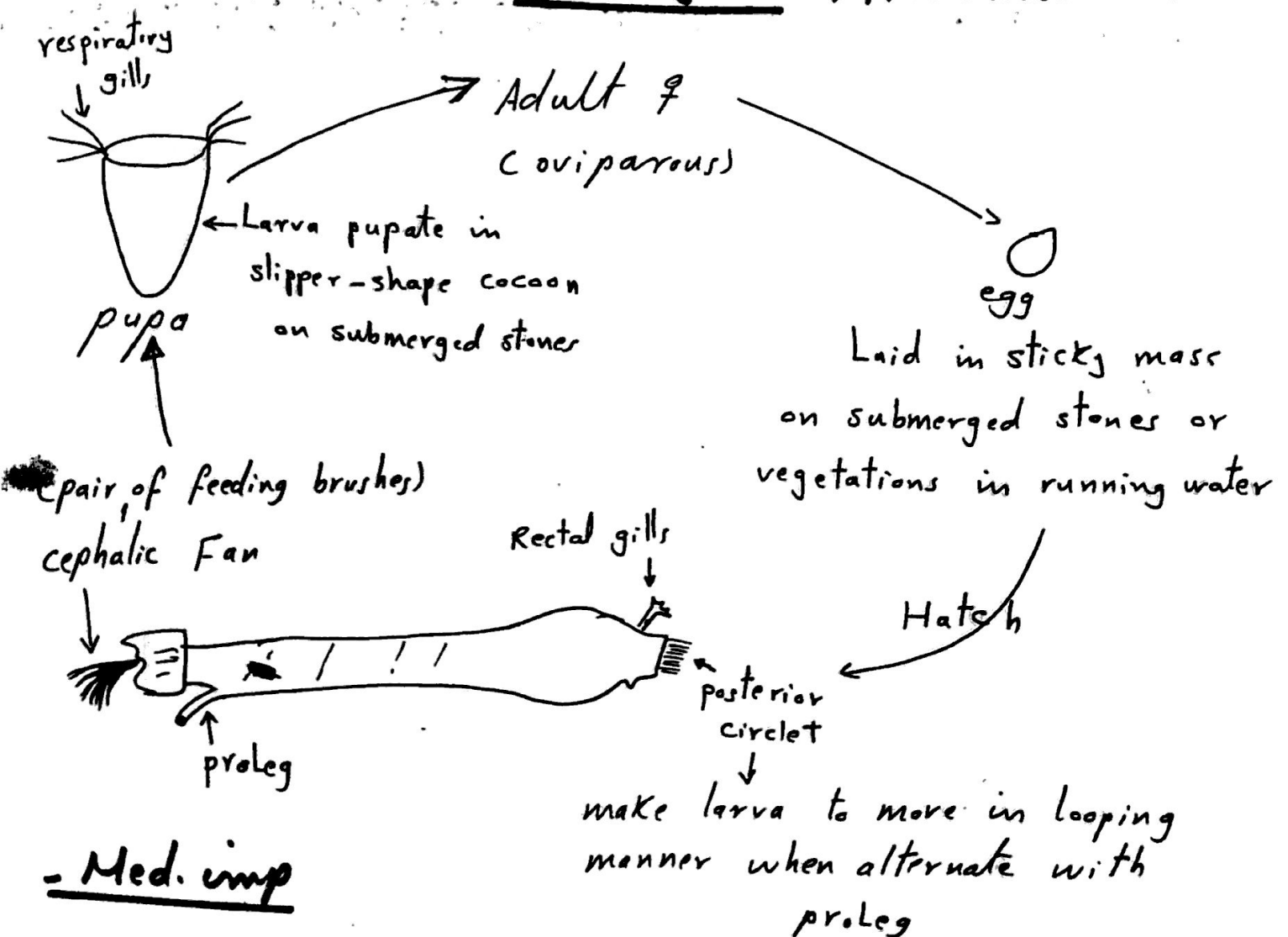
- ① Female → Blood suckers
- ② Transmission of Leishmania
 - L. tropica*
 - L. donovani*

④ Family: Simuliidae

simulium = Black Flies = Buffalo gnats

- Morph → small, black flies
 - Has Humped thorax
- proboscis → Adapted For piercing & sucking
 - only ♀ → Blood suckers.
- Antenna → 11 segment without hairs.
- Abdomen → segmented

Life cycle → Holometabola



- Med. imp

- Transmit → onchocerca
→ Avian leishmaniasis.

⑧ Suborder : Brachycera

Family : Tabanidae.

① Genus : Tabanus = Horse fly = Gad Fly

Morphology

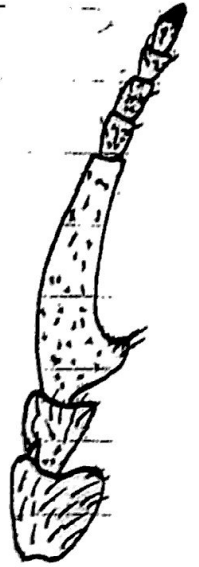
→ Large & yellowish to brown in colour.

→ Large Eye → ♂ → Holoptic.
→ ♀ → Dichoptic.

→ Antenna → Consists of 3 segments

→ 3rd segment → Largest

↳ subdivided into 4 segments
due to annulations



(Antenna)

→ Mouth part → Adapted For piercing & sucking.

→ Maxillary palp → consists of 2 segments

→ Thorax → Has Longitudinal dark strips (|||)

→ Abdomen → consists of 7 segments & has dark Longitudinal strips over yellow background.

→ WING → Large & characteristic

- 1st, 2nd & 6th veins → Are single (Non-branched)

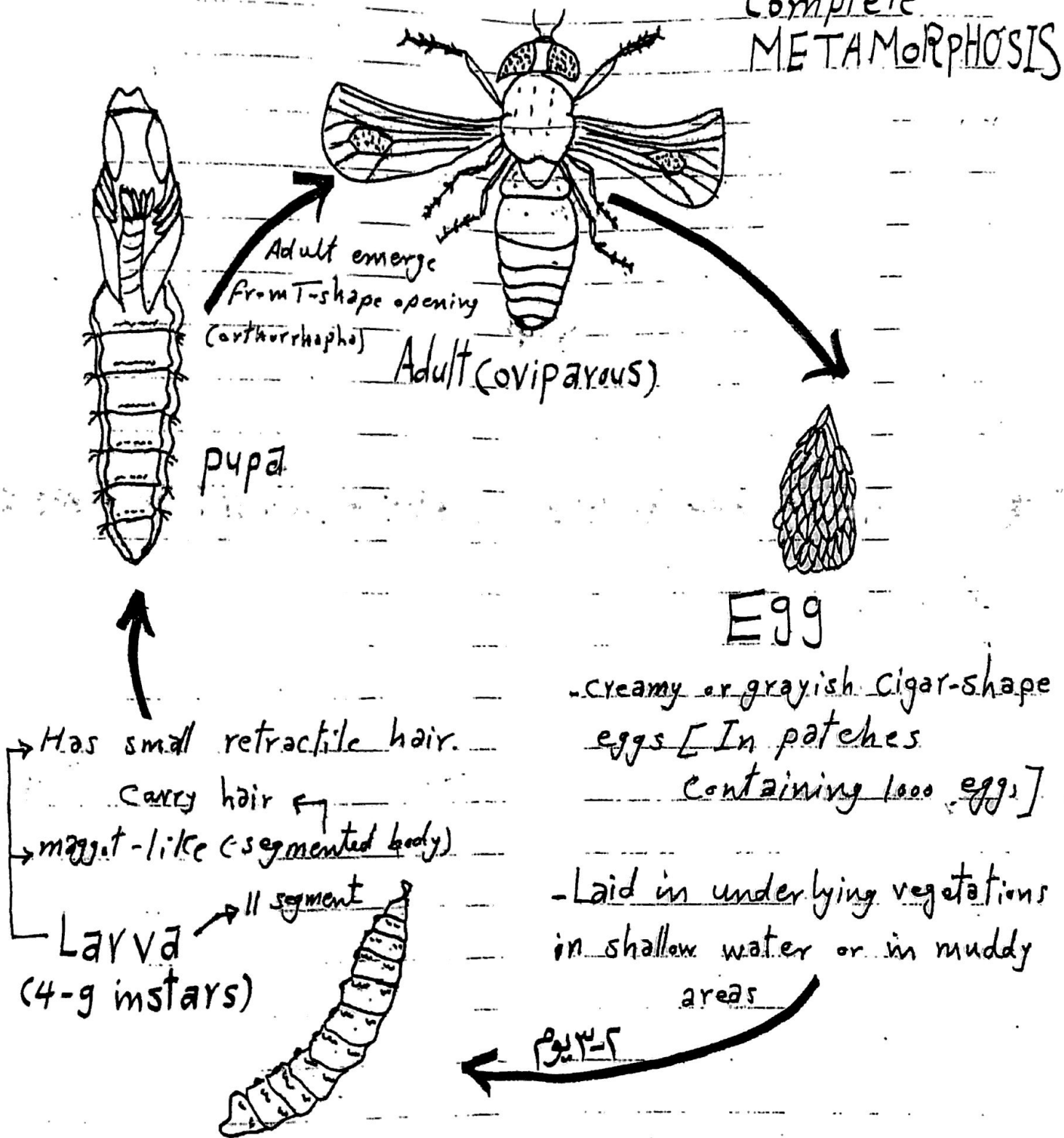
- 3rd, 4th & 5th veins → Are branched & form Discal cell.
(Hexagonal)



Discal cell
(Hexagonal)

Life cycle of tabanus

complete
METAMORPHOSIS



Medical Importance of tabanus

1- Adult → Active during mid sun light (Diurnal) →
Attack the animals by very painful bite →
↓ Food Intake → ↓ productivity.

2. Transmission of disease agents.

(A) Mechanical transmission.

→ Tryp. evansi.
→ Tryp. equinum.

(B) Biological transmission.

→ Trypanosoma theileri in cattle.

(C) Act as vector For

→ Anthrax bacilli

→ Equine Infectious Anemia virus.

② Genus: Chrysops (Deer Fly)

- Similar to tabanus except

a) Has dark bands across the wings.

b) Has coloured eyes.

c) Antenna → 3 joints

d) Importance → act as I.H For human filaria (Loa Loa)

③ Genus: Haematopota.

- similar to tabanus but has Mottled wing.